Transport phenomena in passively manipulated chaotic flows: split-and-recombine reactors

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Résumé en anglais	Static mixers and multifunctional heat exchangers/reactors are being used increasingly in process industries. In the inertial or turbulent regime, mixers often incorporate inserts or corrugated walls whose primary function is to create embedded flow vorticity. On the other hand, in low- Reynolds-number flows, for viscosity or residence time purposes, it is necessary to provide solutions based on kinematic mixing, i.e. the topology of the primary flow, such as split-and-recombine reactors (SAR). The concept is based on passive liquid stream division, then rotation in bends of opposite chiralities, and finally recombination, achieving stretching/folding following the baker's transform. Mixing is efficiently ensured by diffusion without generating prohibitive pressure drops. In this work, a chemical probe is used to study mixing and mass transfer in two different split-and-recombine square duct geometries, SAR-1 and SAR-2 of 3 mm side. Results show that effective mass transfer and mixing can be achieved with a short reactor length and moderate pressure losses; the SAR-1 geometry being more efficient. The chaotic configurations are a good compromise even for higher Reynolds numbers compared to static mixers operating in the transitional regime: they produce moderate pressure losses while enhancing mass transfer.
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